Uncovering a KMSD Approach from Practice

Aboubakr A. Moteleb and Mark Woodman
Middlesex University e-Centre, The Burroughs, Hendon, London, UK
a.moteleb@mdx.ac.uk
m.woodman@mdx.ac.uk

Abstract
There is no credible methodology for knowledge management systems development (KMSD). We report on a KMSD approach that has emerged from an investigation based on action research and grounded theory into a number of business problems experienced by organizations. The KMSD approach is highly participatory, requiring full involvement of members of an organization. It has three interacting aspects: envisioning knowledge work behaviour, design of knowledge management system (KMS), and exploring technology options for supporting the KMS. In the first of these aspects, challenges and opportunities in an organization's current situation are analysed and an improved situation is envisioned to expose knowledge concepts and their properties. In the second, a logical design of a KMS is produced using knowledge entities, knowledge flows and knowledge interfaces; the design is guided and constrained by an organization's structure, culture, and resources. The third aspect is to do with introducing appropriate IT into KMS design, integrating organizational, social and technological aspects of the system. The paper describes this KMSD approach and how it emerged from both practical and theoretical investigation.

Keywords:
knowledge management, knowledge management systems, knowledge management systems development, social network technologies, organizational improvement, action research, grounded theory, small and medium enterprises (SMEs).

1 Introduction

We begin by outlining our research position for addressing problems with KMS and outlining the research framework, particularly the combined approach of Action Research and Grounded Theory. Then, in Section 2, follows a brief characterisation of how organizations instigate work that leads to the type of KMS we believe can help them, and a summary of the KMSD approach uncovered by the research detailed later in Sections 3–5. These sections explain the application of the research framework that uncovered the reported KMSD approach, concentrating on the main points of the research that lead to it. The paper concludes with a reflection on the contribution this KMSD approach brings to both KM research and practice.

1.1 KM Research Position

Organizations lack insight into how to develop KMS, while researchers are yet to find consensus on what constitute KMS. Approaches to developing KMS in organizations remain proprietary and ad hoc with no prospect of philosophical unity (Hahn & Subramani, 2000; Rubenstein-Montano, 2000), which often leads to poor control, management and integration. KM theory itself lacks sufficient cross-pollination of ideas from various influences and adopted philosophies (Moteleb & Woodman, 2007b), covering wide range of phenomena from different perspectives and "missing the opportunity to build synergistically on the work of colleagues in related disciplines" (Subramani et al., 2003). Furthermore, approaches for developing KMS are often predicated on IS development methodologies, which are arguably not adequate for KMSD because of the unique context of KM in organizations (Hahn & Subramani, 2000). As a result, implementation of successful KMS in organizations is deterred by (i) divergence and fragmentation in KM theory and models (Gray & Meister, 2003; Subramani et al., 2003); (ii) lack of insight into how organizations can develop KMS in a broader sense (Rubenstein-Montano, 2000) and (iii) lack of understanding into what role can IT play in supporting KMS (Alavi & Leidner, 1999, 2001; Malhotra, 2005).

Understanding of these issues is hindered by a paucity of empirical research that addresses the relationship among organizational, social and technological aspects of KMS. Thus, the

research question addressed here is twofold: what is a KMS for a particular organization, and how should it be developed in a manner that is generally useful and justifiable. The overall aim of our work is to uncover from practice a methodology (philosophical principles plus practical procedures) for KMSD. The research reported here was carried out with SMEs. In the context of KM, SMEs are not so different to larger organizations: they suffer from poor knowledge communication, they fear losing knowledge, staff who do not share knowledge are a problem, and understanding how to innovate is a permanent challenge. However, SMEs have attributes that help researchers in KM and KMSD: the susceptibility of small organizations to KM-related difficulties resulting from changes in their environment is matched by responsiveness to change and greater agility than is obvious in other types of organization. Having acknowledged differences from and similarities to other categories of organization, the research therefore involves investigating (a) What is KM in the context of organizations? (b) How can organizations develop KMS? (c) How can IT support KMS in organizations?

1.2 Overview of Research Framework

Concerns about repeatable processes for effective KMSD stimulated our goal to provide insight into KMSD for both KM researchers and practitioners. Much detail of our research is described elsewhere (e.g. Moteleb & Woodman, 2006; 2007a). Although originally the research methodology for the work reported herein was conventionally based on the study of the literature and observations of practice, the inconsistencies in the former and the variations in the latter let us to a strictly empirical approach. The strategy of our inquiry is committed to (1) assisting organizations to address actual challenges/opportunities, for which a KMS is a candidate solution, and in so doing (2) advancing research by capturing, evaluating and refining emerging concepts, procedures and techniques for KMSD. The method of the inquiry is, therefore, based on implementing a pair of intertwined Action Research (AR) iterations (see McKay and Marshall, 2001), representing (i) the organization's problem-solving interest and (ii) our research interest; this pairing explicitly separates the roles of practitioner-consultant and researcher, which AR aggregates.

Our AR research strand was refined by the use of Grounded Theory (GT) (Glaser & Strauss, 1967) so as to uncover notions that were present in organizations of knowledge, KM and KMS. Furthermore, GT ensures validation is inherent in the theory – and in our case – the practice that is developed.

The application of the AR pairing reported here was on two SMEs, denoted here as Org1 and Org2. Org1 is a Marketing Consultancy based in the UK, and Org2 is a Franco-British HR and Recruitment consultancy. A team of four researcher–consultants was involved with Org1, which included three in fact finding and one on IT design and implementation. In both organizations only two researcher–consultants were involved on the work reported here.

Rather than postpone a description of the KMSD approach resulting from out AR based enquiry, and for the sake of brevity and clarity, we proceed, in Section 2, by giving an overview of the KMSD approach that emerged and was validated by using GT within an AR framework. Thus, with a clear statement of the KMSD approach articulated, Sections 3 and 4 are able to concentrate on the detail of how the research was conducted and how emergence and validation took place of the first two aspects of the KMSD approach. Section 5 provides an overview of the IT-based design aspect of the KMSD approach.

2 A KMSD Approach for Organizations

In this section we outline how challenges and opportunities that organizations face may be recognised as relevant to KM and outline the uncovered KMSD approach (justified later) that can be utilised to help organizations.

2.1 KM Discourse in Practice

It is rare that organizations articulate problems that they have identified as KM problems, or for them to state an intention to develop a KMS to solve some business problems. Large

organizations that know some KM ideas and think that intranets or document repositories constitute a KMS, sometimes do this, but are now more likely to say they tried and failed with a KMS. Typically, an organization will express some problems in their own terms and/or some need to improve its lot. They will talk about the need to grow, improve some aspect of performance, improve financial stability, etc. An initial consideration of the organization's situation and where it wants to be some time in the future will indicate if there is a KM aspect in what it needs to achieve, and whether our any KMSD approach could be useful.

Such an 'analysis' is often carried out in an unstructured conversation carried out over a period of weeks or months, primarily for primary fact-finding. Typically, what transpires are concerns the organization has about many topics, e.g. loss of skills/knowledge, failures in outsourcing, etc. Challenges/opportunities in organizations are revealed for growth in supply chain management, project performance, sustaining competitive advantage and CRM, for which KMS are candidate solutions.

Having determined that problems could be addressed by KM in two organizations, AR-based projects were agreed to develop a KMS in conjunction with carrying out research. The broad KM issues initially set were: (a) What are KM problems in the context of the organization? (b) What KMS model can help overcome these? (c) What technologies can support a suitable KMS? Our initial AR plan was to work together with staff (1) diagnosing KM situation, (2) designing KMS and (3) assessing candidate technologies.

KM situation diagnosis revealed problems with locating, communicating and interacting with knowledge. This led us to work with the organization on an exploration of challenges and opportunities in its situation to gain insight into what it wanted in the future improved situation.

2.2 Overview of Participatory KMSD Approach

The fully participative KMSD approach is carried out by a team consisting of members of an organization usually aided by external, impartial practitioners. The resulting KMS belongs to the organization which designed and which originated it: unless an organization changes dramatically, its KMS is never completed or terminated, and its behaviour can never precisely be predicted by the organization. It is carried out either in phases or an iterative, possibly agile style. It can be described in terms of three interacting aspects:

1. **Envisioning Knowledge Work Behaviour**: a collective exploration of an improved situation that clearly addresses challenges in an organization's current situation. The exploration is conducted through extended conversations using agreed means appropriate to the organization. The outcome is an explicit, continuously emerging vision of the improved situation to which an organization aspires. This vision consists of knowledge concepts and their properties with dimensions that articulate ranges of values for properties. The vision maps back to original improvement needs of the organization and so is unique to it. Therefore, the vision is owned and maintained by the organization, not by consultants whose roles include assisting exploration (e.g. via probing and mapping) and suggesting avenues for progress.
2. **Designing the KMS**: this aspect is where the team proposes how the knowledge concepts and properties envisioned as part of the improved organizational situation can be represented by knowledge entities, knowledge flows and knowledge interfaces in a KMS. This design is intended to be flexible and to accommodate different and changing perspectives. Although IT options may be considered in high-level terms, this KMS design is not about IT but on how an organization can work with envisioned KM concepts for improvement. Choices made in designing KMS are guided and constrained by an organization's structure, culture, resources etc.
3. **Exploring Technology Options for the KMS**: here the team considers potential technologies to support the KMS design that has been expressed in terms of knowledge entities, flows and interfaces. Potential technical implementations are considered according to degree to which they are likely to integrate organizational,

social and technological aspects of the KMS and according to cost, complexity, availability, etc.

Although we occasionally use terms like 'analysis' or 'design' in describing our approach, it must be emphasised that the role of external practitioners is to assist and guide processes carried out by, and fully owned by, the organization developing a KMS. The team aspect is important, because multiple perspectives are a crucial facet of KM and are needed to achieve validation through the techniques of grounded theory. (And, the impartiality and process knowledge of external practitioners is more important than domain knowledge or expertise.) Hence, an 'analysis' takes place in order to envision a future situation; it is carried out by members of the organization in an exploratory fashion. Because choices will subsequently be made, we can explain the development of a setting for knowledge entities, flows and interfaces as a 'design'.

3 Envisioning Knowledge Work Behaviour

In this section we discuss how the KMSD outlined above emerged from research into the practice of facilitating an organization's improved situation through developing a KMS. Using an AR/GT-based approach (Moteleb & Woodman, 2007b) we identified different themes of concepts from organizations' discourses and practices. We found that concepts were understood in terms of constituent properties, each potentially having a dimension – of range of 'values' describing properties.

We use the notions of **THEME**, concept, *property* and *dimension* from GT (shown in corresponding typographic styles). GT *open coding* was used to uncover various *concepts* related to KM from our investigation of KM challenges/opportunities in orgs. These knowledge work concepts were then aggregated into three themes based on common *properties* found in the concepts using GT *axial coding*. As described in detail below these themes of concepts were: (1) **LOCATING KNOWLEDGE**; (2) **COMMUNICATING KNOWLEDGE** and (3) **INTERACTING WITH KNOWLEDGE**. Note that different fonts and typographic styles are used here to distinguish these different elements.

3.1 Uncovering the LOCATING KNOWLEDGE Theme

A set of emergent concepts in Org1 uncovered this first theme. Concepts such as: «what knowledge is with others?» and «who is working on what?» emerged in envisioning an improved situation, where knowledge workers would be able to locate others' knowledge and understand what they are working on. For example, knowing what knowledge is with others is perceived to be essential for improving project management: "He might have more information that could be valuable for the job but I don't know that he has it", while knowing who is working on what is important for avoiding redundant work, hence improving performance: "One job may be carried out by more than one person without knowing". This theme was confirmed in Org2 through a different set of emergent concepts such as: «what expertise does a candidate applicant possess?»; e.g. understanding what expertise does the candidate applicant have would increase efficiency of matching candidates to vacancies.

Concepts revolving around the **LOCATING KNOWLEDGE** theme share the following emergent properties from both organizations: (1) *knowledge mapping* – indicators to knowledge and expertise with others: "I don't know what kind of information [he needs], this is the first time I come in contact with the graphic designer", and (2) *knowledge openness* – the availability of knowledge to others: "I will not know anything about what is going in the meeting, what is going between [the owner-manager] and designer, I will not be involved in communication with tester …". Another property that emerged from analysing how different concepts led to uncover the same theme is *purpose of knowledge* – the reason why locating knowledge is important. This property emerged as it was noticed that different concepts led to the same theme despite having different purposes for locating knowledge.

One dimension that emerged in association to the property *knowledge mapping* is *degree of similarity*. Conversations revealed that knowledge can be mapped to each other according to *degree of similarity*. Similarities are important for instance among projects: "Projects are very similar because we have been doing a lot of work for public sector" and among documents "I remember which proposal is nearly similar but it would be a problem if somebody else is joining me to do the same thing; they would not have historical knowledge that I do".

The *degree of accessibility* emerged as a dimension related to the property *knowledge openness*. The *degree of accessibility* defines for instance the extent to which knowledge is available to different team members. Whereas conversations with staff revealed that knowledge about projects should be accessible for instance to all team members: "I need to know exactly what they want because I need to take my notes", conversations with owner-manager revealed that other knowledge, such as knowledge about clients, might need to be kept exclusive.

Purpose of knowledge can be represented by a range of *various reasons* for which locating this knowledge is important. For example, although the concepts «who has which expertise?» and «what expertise does a person possess?», emerging from Org1 and Org2 respectively, led to the same theme; the former concept is due to a need to know who to refer to in specific areas of expertise, which is different from the latter, which is due to a need to match a job vacancy to suitable candidates based on their expertise.

Understanding of properties and dimensions in **LOCATING KNOWLEDGE** is critical in developing KMS. Different *degrees of accessibility* and *various reasons* for locating knowledge should be taken into consideration when designing KMS. For example, the degree of accessibility is set by a knowledge owner, yet negotiable between the knowledge owner and requester. Thus, knowledge holders keep ownership of their knowledge; maintaining ownership of knowledge was a concern that emerged from conversations. Also, to emerge was the requirement that KMS should allow for users to determine the extent of *knowledge similarity*.

3.2 Uncovering the COMMUNICATING KNOWLEDGE Theme

Another set of emerging concepts in Org1 uncovered this second theme. In Org1 concepts such as: «communicating knowledge among individuals», «communicating knowledge about clients», and «communicating knowledge of expertise» emerged. For example, «communicating knowledge among individuals» is perceived as important for collaboration and innovation, and hence for improving performance and competitiveness: "There should be clear understanding between me and the designer, me and the client …". The concept of «communicating knowledge about clients» was perceived to be important for understanding clients' requirements, hence for improving client satisfaction: "There is miscommunication in finalising what the creative brief is". This theme of **COMMUNICATING KNOWLEDGE** was confirmed through a different set of concepts in Org2 such as: «communicating knowledge among consultants», «communicating knowledge about candidates», and «communicating knowledge about missions».

Concepts under **COMMUNICATING KNOWLEDGE** share the following emergent properties: (1) *nature of knowledge* – the kind of knowledge communicated: "Questions to define project and direction" and (2) *knowledge value* – the usefulness of knowledge: "It is not just about where [the clients] are now, it is about where they want to be".

The dimension of *nature of knowledge* can be an unordered set of *various types* determined by the knowledge holder or requester. Conversations in Org1 and Org2 uncovered that type of knowledge required about projects or missions for instance: "understand job description, work flow of the job from start to finish" is different from type of knowledge required about expertise: "What should I expect from people and what people should expect from me?".

Degree of suitability and *timing of knowledge* are emergent dimensions associated with the property *knowledge value*. Staff underlined the criticality of being able to communicate appropriate knowledge to relevant stakeholders: "Even though I have to manage

everything and all expectations of the project are connected to me, I am the last person who would be informed of what is going on" at a suitable time: "I probably would not even know it until it is too late!". Whereas some knowledge need to be communicated at the start: "If I have this information at the start!" stakeholders need to understand that other knowledge can only be communicated gradually: "At the time of proposal, the client is not going to give you that much detailed information, plus – not always – that they don't want to put something they do not know themselves neither". Both the *degree of suitability* and *timing of knowledge* communicated therefore affect the workflow.

Understanding properties and dimensions in the theme of **COMMUNICATING KNOWLEDGE** is critical for developing KMS. A KMS design should cater for *various types* of knowledge: this is essential for the KMS to be able to communicate knowledge of value to a requester. Also, a KMS design should allow for users to determine the *degree of suitability* and *timing of knowledge* in relation to what users are doing: it is important for knowledge to reach relevant people at a suitable time. How this knowledge is communicated in terms of type and time is negotiable between knowledge holder and requester. From Org2 this was expected to motivate knowledge holders to communicate their knowledge with others, to be able to receive knowledge from others when needed.

3.3 Uncovering the *INTERACTING WITH KNOWLEDGE* Theme

A third group of emerging concepts uncovered this third theme. In Org1 concepts such as «linking to individuals' knowledge», «linking to projects' knowledge», and «linking to each others' expertise» emerged. For example, it is perceived to be important to meet a client to understand their requirements: "There are things that I could just get from meeting the client". This theme was confirmed through concepts that emerged in Org2, such as «linking to candidates'/consultants' knowledge», «linking to missions' knowledge», and «linking to others' expertise».

Concepts under the theme **INTERACTING WITH KNOWLEDGE** share the emergent property of *knowledge connectivity* – the ability to link knowledge together: "For me the owner-manager is the link". This property emerged from Org1 and was confirmed by the work with Org2. Another property only from Org2 was *knowledge perspective* – the ability to represent different views on knowledge in the system. Conversations in Org2 made clear that knowledge is perceived differently by different users.

One dimension that emerged for *knowledge connectivity* was the *degree of closeness* (or *degree of separation*) to certain knowledge. Conversations in both organizations revealed that the *degree of separation* influences interaction with knowledge. For example more than one *degree of separation* to critical knowledge (e.g. knowledge about clients and their requirements) might make it harder to get relevant knowledge at a suitable time: "I am not involved in anything with the client, so sometimes I might miss some important information". However, sometimes it is imperative to keep more than one *degree of separation* for reasons such as privacy or security especially with external staff. The *degree of separation* doesn't have to remain static, but can be dynamic – changing in different situations.

The dimension that emerged in association to the property *knowledge perspective* was the *range of views* in interacting with certain knowledge. Org2 showed that there is a *range of views* related to the same knowledge. For example, while knowledge about a certain candidate can be viewed in relation to fulfilling a mission by a consultant in Org2, it can be viewed in relation to knowledge sharing by a candidate.

Understanding properties and dimensions in **INTERACTING WITH KNOWLEDGE** is critical in developing KMS. A KMS design must represent the *degree of separation* for users interacting with knowledge. Also, a KMS design should accommodate the *range of views* to be represented and changed by users, because not every user views their relation to certain knowledge in the same way.

4 Designing the KMS

In this section we discuss how the KMSD design elements emerged from research into the practice of designing the organizations' KMS to support their envisioned improved situations. Envisioning an improved organizational situation in terms of KM, uncovered three KMS *design themes* for improving the situation in relation to locating, communicating and interacting with knowledge. These themes were termed **KNOWLEDGE ENTITIES**, **KNOWLEDGE FLOWS** and **KNOWLEDGE INTERFACES**. The purpose of identifying **KNOWLEDGE ENTITIES** is to enable staff to see the big picture by mapping themselves and their work in relation to individuals, artefacts and activities. Identifying **KNOWLEDGE FLOWS** aims at facilitating dissemination of relevant knowledge to staff when they need it and how they need it. Part of this was about adopting best practice; in Org1 it was to give added value to its existing and new customers. For this appropriate **INTERFACES** – points of interaction – among **KNOWLEDGE ENTITIES** needed to be determined. This section explains how these ideas emerged.

4.1 Uncovering Design with KNOWLEDGE ENTITIES

This first KMS design theme was uncovered through a set of emergent concepts such as «who can pass this knowledge to me?» and «to whom can I pass this knowledge?» This theme was collectively explored in a workshop with staff at Org1. Locating, communicating and interacting with knowledge is hindered by increasing dependence on changing freelancers and by staff frequently switching from one role to another. High staff turnover creates a gap in time between the current staff and staff who had left: "There was no information for me or anyone after me"; and this situation was likely to remain unchanged for staff who would join in the future: "I haven't really had anybody to pass that knowledge on to". This had caused over-reliance on the owner-manager, who was the sole link to internal and external individuals, companies and activities.

During the action research (in the workshop with Org1) a KMS was envisaged that would improve this worker situation by having some representation of the knowledge of stakeholders so as to facilitate the theme of **LOCATING KNOWLEDGE**, and in particular to support the properties of *knowledge mapping* and *knowledge openness*. Furthermore, it emerged that the particular KMS for Org1 should maintain flexibility in roles and jobs. Exploring how Org1 thought its business could be improved by **LOCATING KNOWLEDGE**, showed for a variety of reasons that it would be impractical to share knowledge solely among people. Because of the flexibility of roles/jobs it was realised that no one person could know all knowledge related to a project. Moreover, high staff turnover meant that knowledge about ongoing projects would leave with the people and new staff would not be able to access knowledge related to projects or jobs. To this end, all constituents of a KMS should be represented as **KNOWLEDGE ENTITIES**.

Accordingly, a **KNOWLEDGE ENTITY** can be defined as an essential constituent of an envisioned KMS that must be capable of locating knowledge, communicating knowledge and interacting with knowledge. **KNOWLEDGE ENTITIES** could be individuals or companies, who can actually communicate knowledge via different means, or could be artefacts and activities such as projects, jobs, expertise and documents. **KNOWLEDGE ENTITIES** can be within an organization or external, in its environment; e.g. Org1 needed knowledge entities for internal staff and expertise, and for freelancers, external expertise. Org1 staff also helped refine the notion of **KNOWLEDGE ENTITY**, which need not *hold* particular knowledge but can *point* to holders of relevant knowledge. Figure 1 illustrates an individual knowledge entity mapped to other knowledge entities, including other individuals.

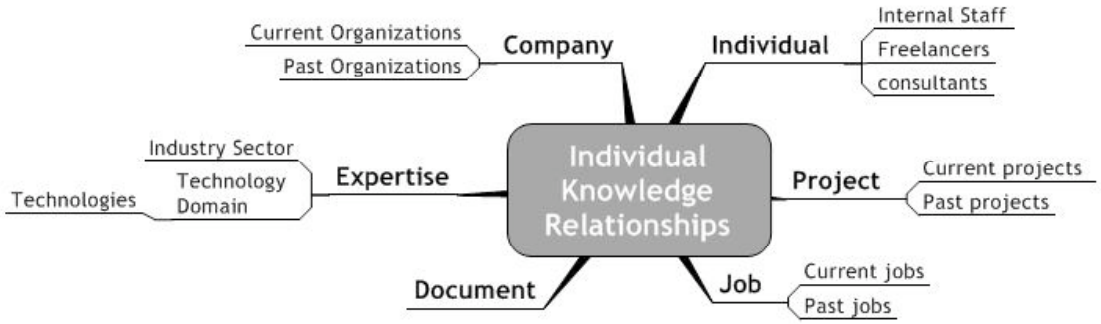

Figure 1: Individual knowledge relationships

In addition, as discussed in section 3.2 KNOWLEDGE ENTITIES are required to identify the *nature of knowledge* that they need from each other (*knowledge type*) and in turn are expected to feedback on received *knowledge value*, for example, in terms of *degree of suitability* and *timing*.

4.2 Uncovering Design with KNOWLEDGE FLOW

This second KMS design theme, KNOWLEDGE FLOW, was uncovered through a set of emergent concepts such as «relevant knowledge reaching relevant persons at suitable time». This theme was further explored with staff during the workshop at Org1, where each participant was asked to assume the role of one KNOWLEDGE ENTITY and articulate: (a) what knowledge they need from others and (b) what knowledge can they give to others, based on their understanding of each other's functions. Staff emphasised the importance for "knowledge to flow" between relevant knowledge entities at a suitable time. Once Org1 had adopted the design theme of KNOWLEDGE ENTITIES, it expressed needs for knowledge to flow not just among individuals and companies, but among projects, jobs and expertise.

KNOWLEDGE FLOW was perceived by staff as the communication of relevant knowledge to relevant KNOWLEDGE ENTITIES at a suitable time. This contrasts with a general argument in literature that KM is about delivering the right knowledge to the right *person* at the right time. The latter implies that we can pre-specify (a) what is the right knowledge? (b) who is the right person? and (c) where and when are the right place and time? The former implies an on-demand ability to identify (a) relevant knowledge, (b) relevant stakeholders and (c) suitable place and time. The emergent requirements thus suggest that a KMS must incorporate a flexible and unfixed design, not knowing how it may evolve.

When designing the KMS to meet the needs of KNOWLEDGE COMMUNICATION as knowledge flows, Org1's staff saw the need for a special type of KNOWLEDGE ENTITY, that they named an "oracle". Because of the issues of staff flexibility and turnover, and the potential danger of "knowledge overload", Org1's staff argued for an oracle entity concerned with knowledge about, for example, "all projects ever taken place in the company" and "all expertise ever known in the company". For example, the oracle representing projects was proposed as knowing about knowledge needed by people for the following: "the planning of my project", "to understand who I am working with", "to understand requirement and deliverables", "the resources that I might need", "the client contacts, the organization contacts", and, "what is the status of the job at anytime". In addition, the oracle representing projects can provide other KNOWLEDGE ENTITIES with the following: "roles in relation to others", "similar projects and best practices", "the big picture", "project documentation".

The KNOWLEDGE ENTITIES interacting with oracles thus became crucial in determining knowledge flows in a KMS. A knowledge communication matrix was devised to map KNOWLEDGE FLOW arising from workshop activities (omitted here for brevity). Figure 2 shows the knowledge flows among knowledge entities for Org1.

4.3 Uncovering Design with KNOWLEDGE INTERFACES

Once **KNOWLEDGE ENTITIES** are identified and **KNOWLEDGE FLOWS** are represented in a KMS design, **KNOWLEDGE INTERFACES** among entities must be defined to facilitate knowledge flow. This last emerging KMS design theme was revealed from Org1 in the workshop when each participant was asked to continue with their roles and think of what are the current and potential points of interaction with each other's knowledge. It was emphasised that current points of knowledge interaction are almost non-existent. Interaction with knowledge entities is mainly through the owner-manager. They envisioned knowledge interaction to happen between any **KNOWLEDGE ENTITY** and another at anytime. For example, they emphasised the need for interaction with individuals working on the same project to coordinate milestones and terms of work: "it wastes lots of time because I spend 3 or 4 days putting it in the right format ... this is work he should be doing". They also emphasised the need for interaction with the client to meet their expectations: "sometimes I might miss some important information that will lose the client ... I hardly get the time to ask [the owner-manager] these questions because he is busy out [of the office] attending meetings."

From practice we understand that knowledge workers envisage a KMS as creating a milieu that enables knowledge interaction – by knowledge flowing via some kind of controlling mechanism among knowledge entities. In Org1 it was indicated that some knowledge entities require direct *knowledge connectivity* between each other while others underlined the importance of managing the control of *knowledge connectivity* – depending on situation and time. For example, staff see that maintaining direct interface (*one degree of separation*) with external contractors facilitates the exchange of information and sharing of knowledge, and establishing direct interface with clients (*one degree of separation*) ensures mutual understanding of requirements. However, the owner-manager stressed that interfaces with some clients and freelancers should be kept through him (*two degrees of separation*) at least temporarily. Figure 2 shows the KMS's potential knowledge interfaces among knowledge entities in Org1.

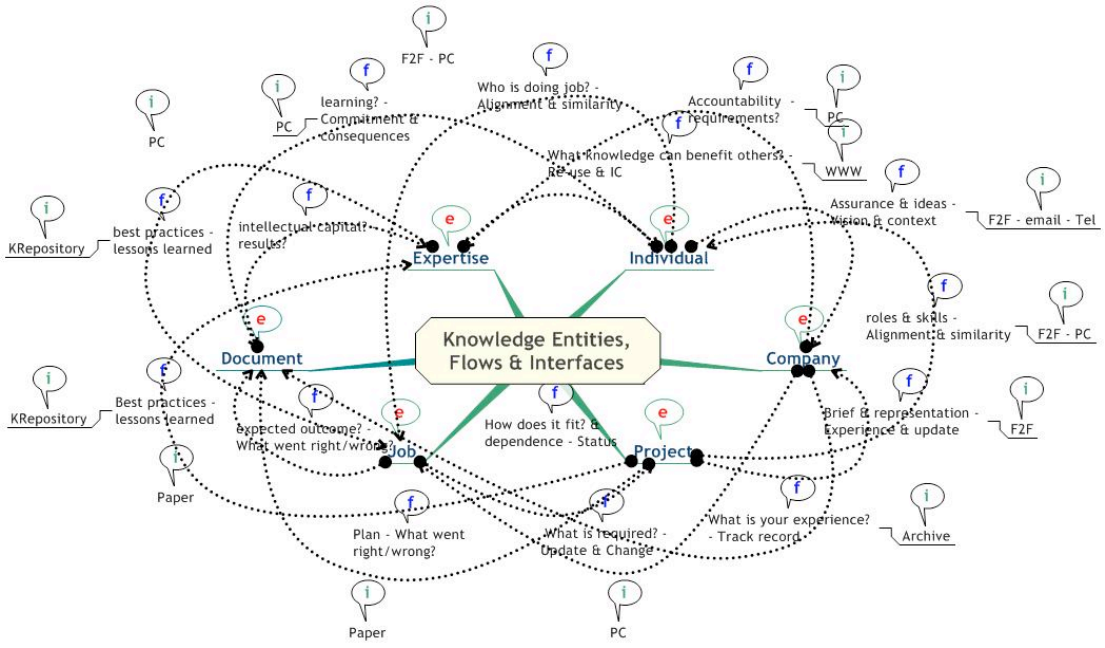

Figure 2: Knowledge Interaction Domain at Org1 (key: 'e'=knowledge entity; 'f' = knowledge flow; 'i'= knowledge interface)

5 Exploring Technology Options

As shown above a KMS is an envisioned setting to improve the situation of an organization by allowing it to locate, communicate and interact with the knowledge that is inherent/embedded

in its work and behaviours. This is achieved by designing a KMS that allows the organization to enumerate and represent its knowledge entities, knowledge flows and knowledge interfaces. For IT to support the KMS means therefore that there must be some way in the IT design to enumerate and represent the organization knowledge entities, knowledge flows and knowledge interfaces. In this section we provide a description of practical considerations rather than give another detailed account of the GT analysis carried out of practice that uncovered the third aspect of the proposed KMSD. Instead in this section we report on and evaluate technology options that were considered in the two organizations.

5.1 Off-the-shelf Software Applications

In Org1 off-the-shelf software applications appeared as a first choice because it would allow the organization to immediately start on implementing the KMS design. Microsoft's SharePoint® and 37 Signals's Basecamp™ were specifically considered as they are associated with offering tools for knowledge-workers' collaboration besides project management, which dominated Org1's KM needs. As a result of the first AR cycle at Org1, it started using Microsoft's Windows SharePoint® Services 2.0 (WSS 2.0), together with Microsoft's SharePoint® Portal Server 2003 (MSPS 2003) to support the design of its envisioned KMS. In parallel to this, the company was exploring the 'Software as a Service' (SaaS) project management tool Basecamp™ available online at the time.

Although neither application directly supported the KMS design, with some effort the Microsoft's SharePoint® and 37 Signals's Basecamp™ available versions at the time could have been configured to simulate knowledge entities, knowledge flows and knowledge interfaces. For example, WSS 2.0 was configured to represent knowledge entities by adding new users on the MSPS 2003 and configuring their attributes and access rights. Like Microsoft's SharePoint®, Basecamp™ was configured to represent knowledge entities by adding new 'users'. Both options were seen as expensive because licensing prices were based on users, so representing multiple instances knowledge entities such as Expertise as a 'user' added directly to costs.

When considering both applications for knowledge flows representation, they were both perceived to be able to support some basic recording of knowledge flows using log files. Likewise, when it came to representing knowledge interfaces, the available versions of both SharePoint® and Basecamp™ could support some recording of the different interactions.

However, neither application catered for all the properties and dimensions for locating, communicating and interacting with knowledge. For example, for locating knowledge neither SharePoint® nor Basecamp™ allowed for mapping relationships among knowledge entities. Also, neither application at the time allowed for even basic representation of the nature or value of knowledge communicated. Furthermore, neither application allowed for any representation of knowledge connectivity, let alone allowing for multiple perspectives required for different knowledge interfaces. On the other hand, the versions of both application at the time had limited visual representation of flow among knowledge entities is useful in showing who is communicating with whom about what at any time.

Although Microsoft's SharePoint® and 37 Signals's Basecamp™ continued to improve and add many features in versions that appeared after the first action research cycle with Org1, evaluation by the team at the time concluded that they still did not fully support adequate enumeration and representation of knowledge entities, knowledge flows and knowledge interfaces. For example, for facilitating knowledge flows and interactions the newer Microsoft's Windows SharePoint® Services 3.0 (WSS 3.0), together with Microsoft's Office SharePoint® Server 2007 (MOSS 2007) as well as newer updates of the 37 Signals's Basecamp™ SaaS incorporated social technologies such as blogs, wikis and RSS to facilitate and motivate communication and collaboration among project members. Although such improvements and additions fell short of providing for essential requirements of Org1's KMS design, these were welcomed because they overcame criticisms by Org1 of earlier versions of SharePoint® and Basecamp™ to do with their inflexibility and hierarchy – as will be explained in the next section.

Consequently, it was considered that a bespoke KMS software application would be more beneficial to allow for adequate representation of knowledge entities, knowledge flows and knowledge interfaces.

5.2 Bespoke KMS Software Application – A Proof of Concept

Participatory evaluation of commercial, third-party systems in the context of their potential support to Org1's KMS design led to the belief that off-the-shelf software applications were not suitable, in spite of their many customisable features. Therefore, it was decided to develop a prototype software application to support the KMS design that had emerged.

In our workshops the Org1 members explained that they needed a software application, or rather a "space" that would be more "social", "unofficial" and "flexible" and that would become part of their daily work. To this end, Keco (for 'knowledge ecosystem'), was developed as a proof of concept.

Keco was based on integrating social technologies and tools to provide for the emerging concepts in exploring KMS technology options: social, unofficial, flexibility and that is part of their daily work. Keco used blogs to represent knowledge entities including those shown in Figure 2: *individual*, *company*, *project*, *job*, *expertise* and *document*. For example, as depicted in Figure 3, each *project* knowledge entity is listed connecting it to the corresponding *company* knowledge entity next to it. Each knowledge entity could publish articles and link them to other knowledge entities using simple HTML tags.

Moreover, Keco allowed for conversations, and hence communicating and interacting with knowledge, through wikis, which could also represent some knowledge entities and be linked to other entities.

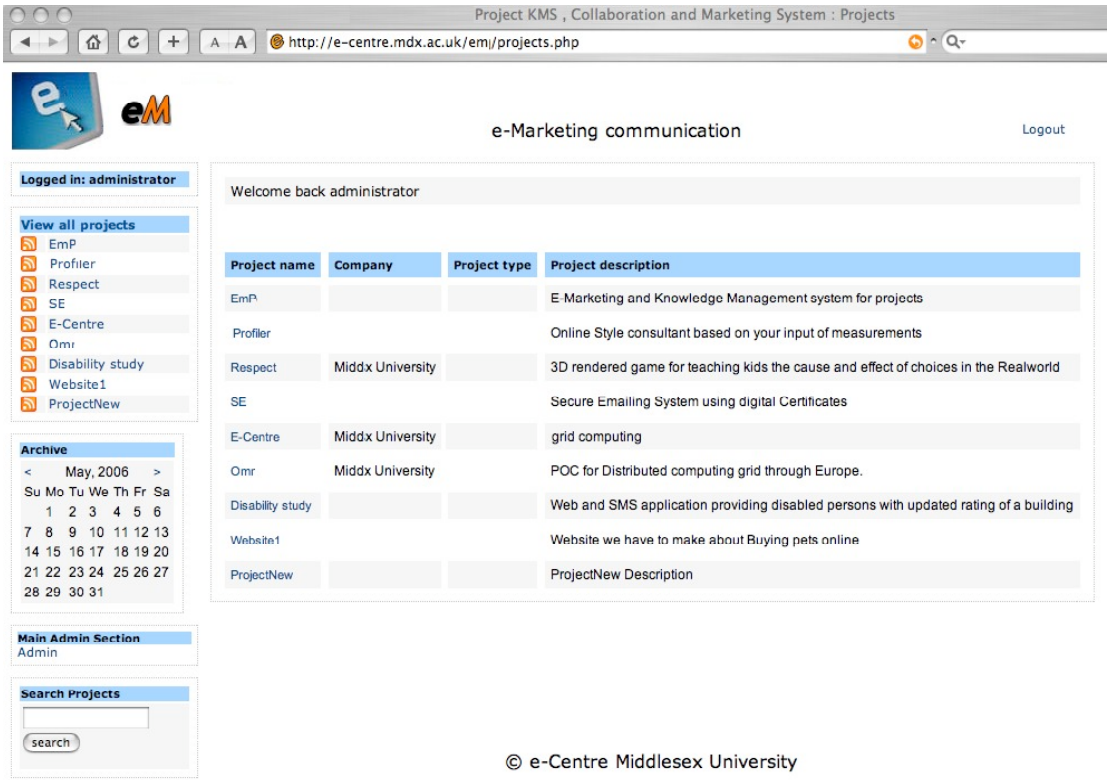

Figure 3: Keco Projects User Interface

Clicking on any of these knowledge entities would link to a blog space, where articles can be added or edited as shown in Figure 4. Each article is linked to a specific knowledge entity through identifying a topic. Furthermore, RSS was used to communicate changes and

updates, basically any activities, of interest to the knowledge entities whenever a new article is created or updated.

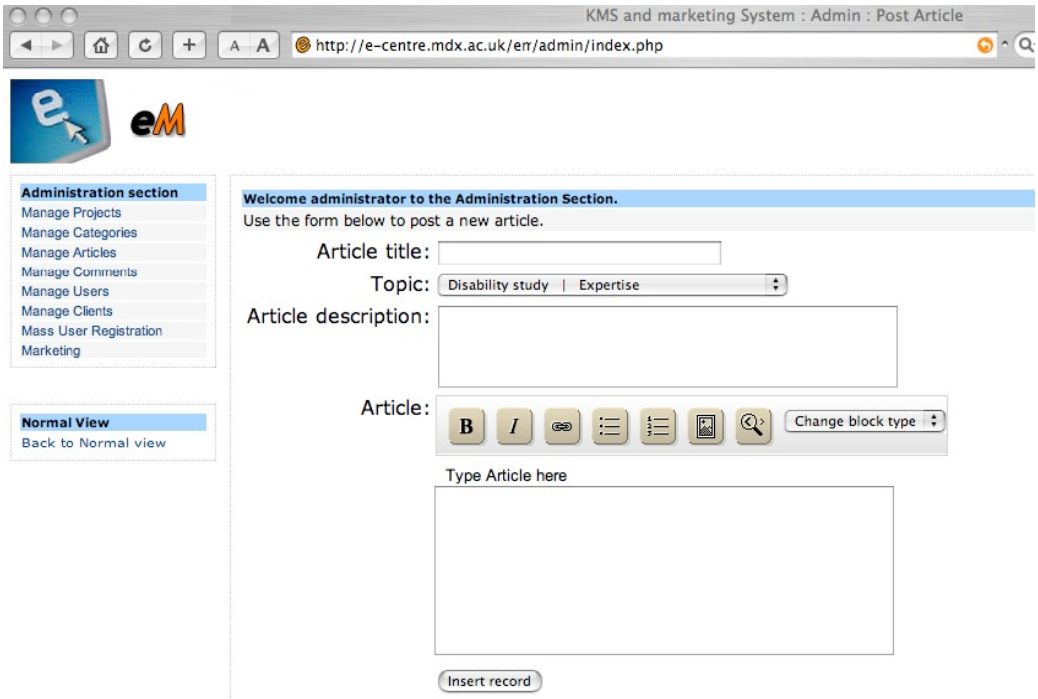

Figure 4: Keco Adding/Editing Entry User Interface

Although Keco provided technical support for the envisioned KMS of Org1 and later of Org2, it did not work for either organization for different reasons. The one reason that is related to KMS design is that Keco was no more than another application that tried to control the entities and their knowledge. The practice of envisaging improved future knowledge-work behaviour, and designing an appropriate KMS had concentrated on enabling functions and not constraining them. Conversations with knowledge workers in both organizations regarding the use of Keco revealed that it was essential for them to keep "ownership" of their knowledge. They welcomed sharing their knowledge with other *individuals* and the *company*, but they wanted to know that they could access this knowledge and any interactions with others' knowledge even if they were no longer part of the company. In other words, they perceived this knowledge as their own personal intellectual capital.

This post-employment behaviour had not emerged in the action research study and so the knowledge workers considering Keco saw it as being inflexible and supporting the hierarchy of the organization – a hierarchy of no relevance to them once they would have moved on.

6 Conclusion

This paper has described a formalised approach to KMSD and the research inquiry that uncovered it. The KMSD approach has three interacting aspects: (1) envisioning knowledge work behaviour, (2) designing the KMS, and (3) exploring technology options for the KMS. The KMSD approach is highly participatory; it must be carried out by a team consisting of members of an organization usually aided by external, impartial practitioners (who act as guides rather than experts). The resulting KMS belongs to the organization which originated it.

In the context of an overall aim to uncover from practice a methodology for KMSD, the research question addressed here is twofold: what is a KMS for an organization, and how should it be developed in a way that is generally useful and justifiable. The research inquiry was carried out with two SMEs, typical of organizations that suffer from KM problems. It was carried out using action research, and so was committed to addressing the organizations'

challenges and opportunities. The detail of the KMSD approach was uncovered using grounded theory.

The paper described how grounded theory analysis was used to uncover the KMSD approach, particularly the themes in the first KMSD aspect of knowledge work behaviour and the design elements for a KMS in the second KMSD aspect. By way of contrast, the third aspect of the KMSD approach, exploring IT options, was discussed in practical terms. In preference to commercial off-the-shelf software, a bespoke proof-of-concept application, Keco, was built using social network technologies to support the KMS needs of both organizations. Ultimately, Keco was rejected by knowledge workers who expected it to provide for their personal knowledge needs after leaving their organization – a factor that had not emerged during the action research.

The inquiry's contribution to practitioners is to introduce the validated KMSD approach and a validated KM model grounded in organizational practice. This model – locating, communicating and interacting with knowledge – offers organizations, KM practitioners and IT designers an insight into developing KMS, a standard approach for integrating KMS across departments and organizations, and a common basis for communication among practitioners.

This inquiry's contribution to KM researchers is the research framework that uncovered a grounded, validated approach to KMSD that emerged from practical concepts, procedures and techniques. This approach includes a KMS architecture – knowledge entities, flows and interfaces – that captures emergent concepts that appear to be common for KMSD in organizations. By creating the situation in which procedures and techniques for developing KMS emerge from practice, our KMSD approach is provably grounded. However, it could be further refined by using for different KMS in different types of organizations.

The first action research cycle for designing KMS uncovered a model consisting of knowledge entities, knowledge flows and knowledge interfaces. The second cycle confirmed the model, and refined and extended it. Knowledge entities were determined to be essential system constituents that hold and both send and receive knowledge. Knowledge entities identified in first iteration of an Action Research cycle were individual, company, project, job, expertise and document. The second cycle uncovered product as a knowledge entity.

Knowledge flow was refined to be a representation of knowledge communicated among entities and staff from organizations uncovered a matrix of knowledge flows and interfaces among knowledge entities. The second organization further extended and refined the knowledge matrix, especially knowledge interfaces.

An assessment of technology options for the designed KMS in the first AR cycle highlighted some customizable, off-the-shelf software that could potentially support the KMS design. Eventually we developed bespoke software based on social technologies.

The work reported here was on how the approach emerged from work with two organizations – two SMEs. These are an important category of organization because of their vital role in economic growth and their susceptibility to changes in the knowledge-based economy. In fact KMS are particularly critical to SMEs because they rely on external expertise – often dispersed in time and place to be able to compete with larger organizations offering integrated services. However the number of organizations and types may be seen as limitations to the scope of our practical approach. Although the Grounded Theory methods do not require numerical strength for conclusion-validity, as trained sceptics we recognise the urge of practitioners and researchers to see more examples of the model in practice and to see a variety of types of organization. Work is underway that addresses such assumed concerns. Until this is completed, a perception of limited applicability must be accepted, even though Grounded Theory justifies our confidence.

Our research is concerned with the theory and practice of KMSD. Through a rigorous action research-based process, augmented by Grounded Theory, we have been developing a KMSD methodology from which a light-weight practical approach is apparent. This paper has described this approach, which is itself is a significant contribution to the discipline as its detail is validated by empirical work and explicit and defensible concepts. Further work will consider

how personal knowledge needs might be accommodated in an organizational KMS, especially when an individual's KM needs no longer coincide with that of the organization that owns the KMS.

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